

problem occurring according to the interparticle vacancy, here
are separately prepared a suspension or a dispersion liquid
dispersed of the ultrafine ceramic oxide powder in an organic
dispersant and a ceramic sol solution having same or similar
composition with the ultrafine ceramic oxide powder.

The ultrafine ceramic oxide powder is used dispersed in an
organic dispersant as for which is mainly used alcohols such as
ethanol and methoxy ethanol, and acetones such as acetone and
acetyl acetone.

It is preferable that the content of the organic dispersant
is 1-500 ml per gram of the ultrafine ceramic oxide powder. It
is because adequate dispersion does not arise if the content of
the organic dispersant is lower than 1 ml per gram of the
ultrafine ceramic oxide powder while if the content is higher
than 500 ml per gram of the ultrafine ceramic oxide powder then
the oxide powder is diluted to be of exceedingly low viscosity.

The ceramic sol solution is made based on water or organic
solvent which can be used from among a variety of organic
solvents but is preferable to be mainly acetic acid, dimethyl
formamide, methoxyethanol, alcohols, glycols etc.

Then the ceramic sol solution and the suspension of the
ultrafine ceramic oxide powder which are prepared separately are
mixed. The mixing ratio of the ultrafine ceramic oxide powder
and the ceramic sol solution may be preferable if the content of
the ceramic sol solution is 1-500 parts by weight based on the
weight of the ultrafine ceramic oxide powder when the powder and
the suspension are mixed.

Thus if the ultrafine ceramic oxide powder and the ceramic

sol solution are mixed, the most of voids occurred after stacking is filled by the ceramic sol and the sol is transferred to ceramic particles during thermal treatment process after the film formation so that voids substantially decrease.

5 And as the ceramic sol itself has electric charge and is compatible with both the ultrafine ceramic oxide powder and the solvent, it is feasible of stabilization of the suspension and the surface electricity charge treatment of the ultrafine ceramic oxide powder even without separate operation and pH control medium.

10 If a work electrode attached of substrate and an opposite electrode dip into sol solution mixed of the ultrafine ceramic oxide powder and the ceramic sol solution, the ceramic sol and the ultrafine ceramic oxide powder polarized in the sol solution phase move to the work electrode to form a film on the substrate attached at the work electrode.

15 Metal, resinous polymeric organic compound, or ceramics may be used as a vibration plate.

20 As for the metal for the vibrating plate, nickel (Ni) or stainless steel is mainly used; as for the resinous polymeric organic compound, polyester, polyimide, or teflon resin is mainly used; and as for the ceramics, alumina (Al_2O_3), zirconia (ZrO_2), silicon (Si), silicon carbide (SiC), silicon nitride (Si_3N_4), silicon dioxide (SiO_2), or glasses is mainly used.

25 At this time, it may be postfinished after generally forming the film on substrate, or screen, mold, or mask might be set on the substrate so as to form a piezoelectric/electrostrictive film element of desired type.

Whence it is preferable to form the piezoelectric/electrostrictive film element in the thickness of 1-100 μm , and may be more preferable to form in the thickness of 5-30 μm .

5 The formed piezoelectric/electrostrictive film is thermally treated to remove the remaining solvent and convert the contained sol into fine ceramic particles. Thus the solvent is removed by thermal treatment and the ceramic sol acts as a reaction medium on oxide particle surface to induce the bonding between ultrafine ceramic oxide particles.

10 The reason for the reaction is sufficient only by the thermal treatment at the low temperature of 100-600°C is that a reaction same as a sintering may take place by mutual reaction of bonding between the ultrafine ceramic oxide powder and the raw material of the constituent ceramic elements in the ceramic sol solution. And so the added organic materials are removed during the thermal treatment.

20 Specifically in case of the polymeric organic compound, because the substrate may be damaged if thermally treated above 500°C, it is preferable to thermally treat it at 100-300°C in case where the polymeric organic compound is used as a substrate.

25 So more preferably thermal treatment may be conducted at 150-300°C, which temperature range can suitably secure the crystallinity and formability of the piezoelectric/electrostrictive film element even as the range is for the thermal treatment at considerably low temperature.

And the method may further comprise a step of drying the formed piezoelectric/electrostrictive film element before the